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VOL. XIV.] OCTOBER, 1922. [No. 12.

Notes on Nesting of *Polistes* (Hymenoptera, Vespidæ).[1]

BY DWIGHT ISELY,
Department of Entomology, University of Arkansas.[2]

BY FAR the most abundant paper wasp in northwest Arkansas is *Polistes metricus* Say.[3] Its nests can be found almost anywhere attached to trees or shrubbery or under the eaves of buildings. They are often quite numerous. As, for instance, along a stream for a distance of about three hundred yards the writer counted twenty-two nests early in May, 1921. In a small block of apple trees, somewhat less than an acre in extent, seven nests of this species were noted in October of the same year. About premises of the insectary of the United States Bureau of Entomology at Bentonville, Ark., the same season, five nests were built.

The following notes relate largely to one of these nests which was built just outside of the screen, and under a shutter, of the insectary, conveniently situated for observation from within, where complete immunity from stings could be enjoyed. The history of the nest is as follows:

The stem of the nest was begun May 18 by a female wasp. On May 20 three cells were started, and three more were begun the next day. As soon as the base of each of these cells was built, an egg was deposited in it; thus six eggs were deposited in two days. From now on cells were added less frequently, but considerable time was given to enlarging those already started. On May 23 two more cells were started, and the walls of one of the first cells were 8 mm. long. Two more cells were added May 28. An egg was deposited in one of these, but not in the other until May 30. This marks the end of the

1. Published with permission of the Secretary of Agriculture.
2. Formerly with U. S. Bureau of Entomology: Deciduous Fruit Insect Investigation.
3. Determined by Mr. S. A. Rohwer, U. S. Bureau of Entomology.

first stage in the history of this nest. No more cells were added until near the time of maturity of the offspring.

Hatching began May 30 with the three eggs which had been deposited on May 20. Two eggs deposited on May 21 hatched on May 31 and one on June 1. The incubation period of five eggs was ten days and of one eleven days. Records of incubation were not complete for the other eggs, but they required about the same time.

The wasp larvæ grew rapidly, but at an unequal rate. This was apparently due to the fact that some were favored in feeding. The first grub spun the cap, closing its cell for pupation June 9, and the other cells of the first-hatched larvæ were closed June 1, 13, 15, 17 and 21, and July 9, making the larval period vary from ten to thirty-eight days. In contrast to this extreme variation, the period required for pupation was exactly eighteen days in all instances, the wasps maturing on June 27, July 1, 3, 5, 9 and 27. All were females.

For two days after emergence from its cell the first wasp stayed on the nest. After that it began going to the field, and soon was doing most of the field work; that is, bringing in paper for nest building and partially crushed insects for larval food. Caterpillars were apparently the most frequent prey. The parent wasp stayed at home, received supplies from the worker, and at first did most of the feeding of the larvæ and actual adding to the nest. As the number of offspring increased, there were always several on the nest ready to meet a field worker and unburden it of its supplies. The field workers also often engaged in feeding the grubs.

Shortly before the emergence of her first offspring, on June 21, the parent wasp began three new cells and deposited eggs in them. Three more cells were started on June 27, and from then on building progressed rapidly. By July 10 there was a total of thirty-one cells in the nest, and all of the cells vacated by maturing wasps were renovated and eggs were again placed in them. At the close of the season a total of eighty-two cells had been built.

This nest seemed to be fairly representative for rate of growth and size. Two other nests which were started about the same time were observed occasionally. On July 9 one had three wasps and fourteen cells; the other had six wasps and twenty-four cells. At the end of the season they had seventy-four and 102 cells, respectively. The total number of wasps in any of the colonies was not definitely known.

The first male wasp appeared August 12, and after this for at least three weeks there was a large emergence of drones. The time

of appearance of the first sexually mature females was not noted. The males did not go afield with the regularity of the females, but spent most of their time on the nest, so that they made up the greater proportion of wasps on the nest during the day. These males were apparently waiting on the nest for the emergence of sexually developed females. What was probably a preliminary to mating was observed twice. As a female wasp was emerging from her cell she was pounced on by a male and then by all the males on the nest. This mass of wasps fell in a ball to the ground. When disturbed by the writer, they separated. Mating was not observed. A similar performance was noted at another nest later in the month.

Observations were not made regularly after this time, the writer having left Bentonville, but by the middle of October all males had left the nest. A large number of females still collected there, but all the brood had emerged and all activity had ceased.

Considerable opportunity was offered to observe the workings of the sense of direction, or rather the apparent lack of any such sense. When the colony consisted of only a few individuals all of the wasps apparently depended on local observations for finding their way to their nest. Any change in the insectary shutters was confusing to them. The oldest of the workers, when returning from the field, was observed to alight on the shutter about a foot below and two feet to the north of the nest. She would run on a horizontal line below the nest and continue until she was about six inches past it, when she would turn at a sharp angle and go directly to the nest. This path was always followed unless the shutter was tampered with, when the wasp could scarcely find the nest at all. None of the other wasps followed this same path, but each apparently had its own system.

The overwintering queens of *Polistes* are sometimes gregarious, a number of them starting a colony together in the spring. I have never observed them working together in building an absolutely new nest, but on several occasions I have seen a small number—never more than seven—of overwintering queens renovate a large nest left from the season before and start a colony together. This probably accounts for the very large nests of several hundred cells that frequently are found. These exceedingly numerous colonies were much more pugnacious than the small colonies. In fact, colonies of but a few wasps are inclined to be shy rather than pugnacious.